65-435 AU 1303 48010
GB 002044751 A
OCT 1980

(12) UK Patent Application (19) GB (11) 2 044 751 A

(21) Application No 8009149
(22) Date of filing 18 Mar 1980
(30) Priority data
(31) 7902201
(32) 21 Mar 1979
(33) Netherlands (NL)
(43) Application published
22 Oct 1980
(51) INT CL³
C03B 37/025
(52) Domestic classification
C1M 401 QB
(56) Documents cited
None
(58) Field of search
C1M
(71) Applicant
N. V. Philips' Gloeilampenfabrieken
Emmasingel 29, Nl-5611
Eindhoven, The Netherlands
(72) Inventors
Johannes Feenstra,
Marius Annie Frans Klop,
Wilhelmus Cornelis Petrus,
Jan Gerard Jacob Peelen,
Hermanus Nicolaas Tuin,
Maria Meerman
(74) Agent
R. J. Boxall

(54) **Method of Making Optical Fibres**

(57) A method of making an optical fibre, in which method an optical fibre preform P is heated in a furnace 5 so as to melt one end of the preform P. A fibre F is drawn from the molten end of the preform P and is withdrawn from the furnace 5, the portions of the preform P and fibre F which are located inside the furnace are enveloped in an inert gas stream which enters the furnace 5 through a supply duct 49. The drawn fibre F is cooled, provided with a coating of a synthetic resin in a coating device 9, and the coated fibre is wound onto a reel 15. A problem in such a method arises from contaminants which settle on the fibre F in the furnace 5. An overpressure of the inert gas is maintained inside the furnace 5, and a stream of gas enveloping the fibre F passes from the inside of the furnace to the outside of the furnace through a condenser element 61.

x 1 2 5 a, 11, 19-20
4 10, 25

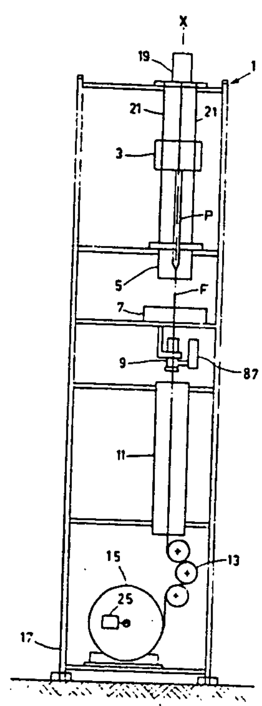

FIG.1

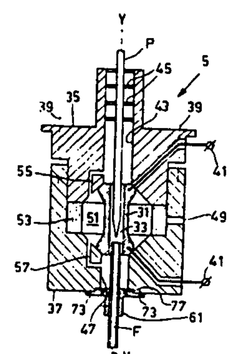

FIG.2

GB 2 044 751 A

65/435

2044751

1/2

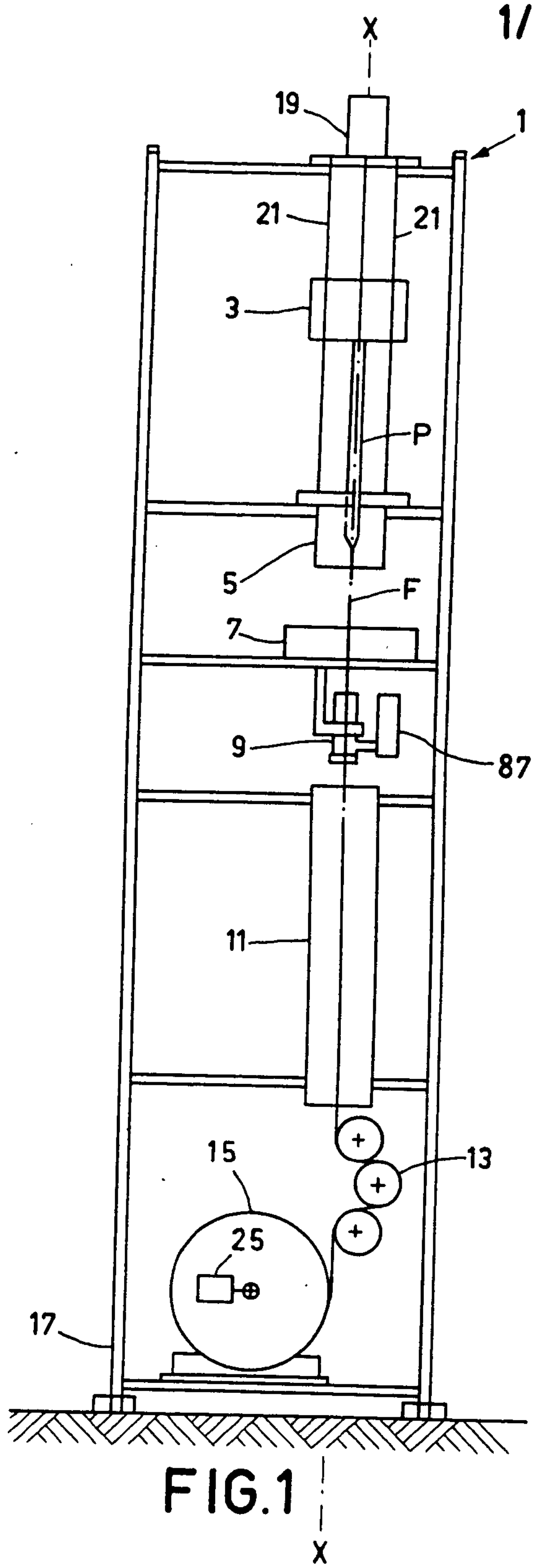

FIG.1

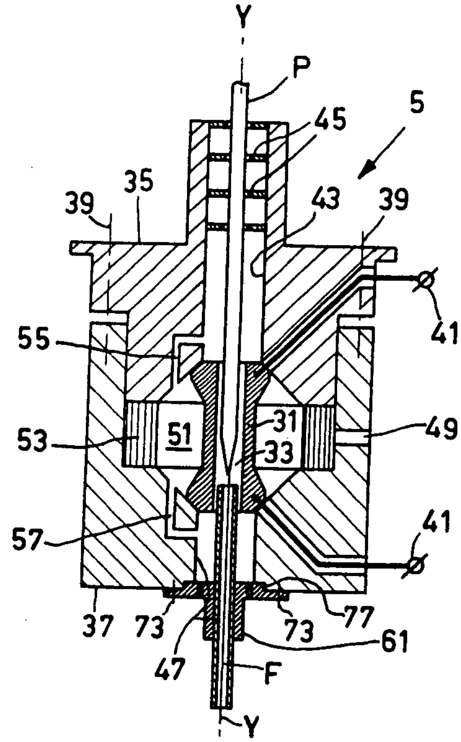

FIG.2

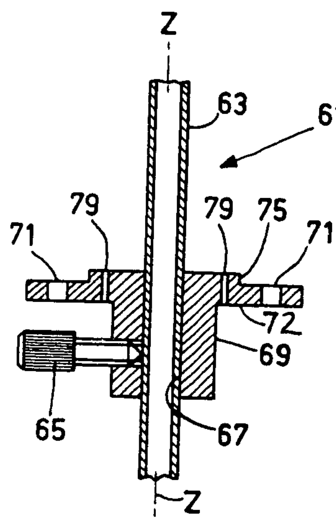

FIG.3

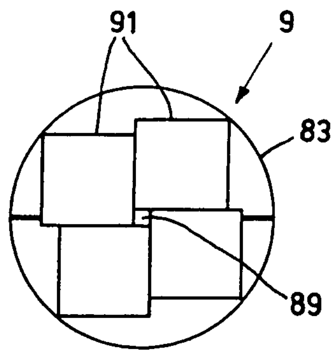

FIG. 4a

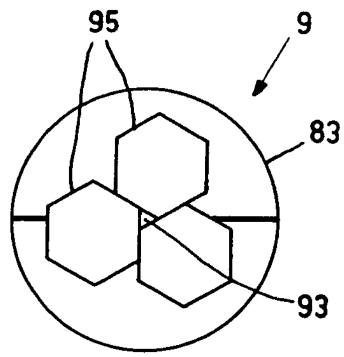

FIG.5a

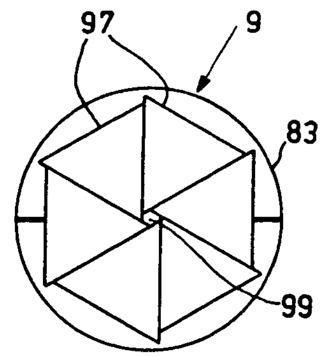

FIG.6a

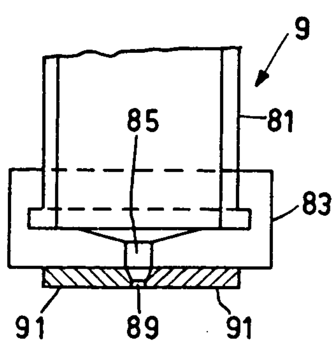

FIG. 4b

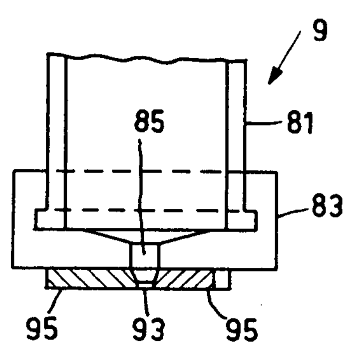

FIG. 5b

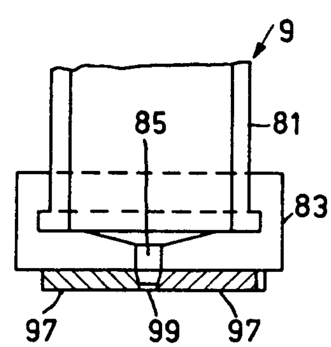

FIG.6b

SPECIFICATION

Method and Apparatus for Manufacturing Optical Fibres

The invention relates to a method of manufacturing optical fibres, an optical fibre preform being heated in a furnace so as to melt one end of the preform, a fibre being drawn from the molten end of the preform and withdrawn from the furnace, the portions of the preform and of the fibre located in the furnace being flushed with a gas, after which the drawn fibre is cooled and provided with a coating which is subsequently dried, and finally the fibre thus obtained is wound onto a reel.

Such a mehod is known from the article "Preform Fabrication and Fiber Drawing by Western Electric Product Engineering Control Center", published in "The Bell System Technical Journal", Vol. 57, No. 6, July—August 1978, pages 1735 to 1744.

The preform is heated in this known method by means of a graphite resistance-element. Owing to its thermal and mechanical properties, *i.e.* a high thermal shock resistance and a suitable strength at high temperatures, graphite is extremely suitable for this purpose; moreover, graphite is comparatively cheap, is available in a pure form and is easy to work. However, graphite has the drawback that at the operating temperatures of approximately 2000°C, it is subject to substantial oxidation. It is known that the drawing conditions may adversely affect the strength of the drawn fibre. Contamination of the fibre by dust particles as a result of the deposition of reaction products (which have been formed, for example, by reactions between components of the furnace and the atmosphere inside the furnace) such as silicon carbide or silica particles will damage and impair the properties of the fibre. Contamination of the fibre by dust particles can be avoided by drawing the fibre in a dust-free environment. The formation of reaction products can be limited by maintaining an overpressure of an inert gas atmosphere in the furnace, so that the entry of air into the furnace is prevented. Settlement of reaction products on the fibre can be minimized by surrounding the fibre with an inert gas stream.

It is the object of the invention to provide a method which results in a quality improvement and an increased tensile strength of the optical fibre manufactured by this method compared with optical fibres made by prior art methods.

The invention provides a method of manufacturing an optical fibre, comprising the steps of heating an optical fibre preform in a furnace so as to melt one end of the preform, drawing an optical fibre from the molten end of the preform, withdrawing the optical fibre from the furnace, enveloping the portions of the preform and the optical fibre which are within the furnace in an inert gas stream, cooling the optical fibre, coating the optical fibre with a layer of synthetic resin and winding the coated optical fibre onto a reel, wherein the gas stream enveloping the optical fibre passes from the inside of the furnace to the outide of the furnace through a condenser element which surrounds the optical fibre, and wherein an overpressure of the inert gas is maintained inside the furnace with respect to the pressure outside the furnace. The optical fibre may be coated, for example, by extrusion melting, melting a finely-divided powder, coating with a liquid synethetic resin which is subsequently cured, or with a layer of suspension or a solution of a synthetic resin.

An optical fibre may be manufactured by a method according to the invention comprising the steps of heating an optical fibre preform in a furnace so as to melt one end of the preform, drawing an optical fibre from the molten end of the preform, withdrawing the optical fibre from the furnace, enveloping the portions of the preform and of the optical fibre which are within the furnace in an inert gas stream, cooling the optical fibre, coating the optical fibre with a lacquer, drying the coated optical fibre, and winding the dried coated optical fibre onto a reel, wherein the gas stream enveloping the optical fibre passes from the inside of the furnace through a condenser element which surrounds the optical fibre, and wherein an overpressure of the inert gas is maintained inside the furnace with respect to the pressure outside the furnace.

The condenser functions as a cold spot, so that gaseous reaction products settle on the condenser and the optical fibre itself is not contaminated by condensed reaction products.

Comparative measurements have revealed that optical fibres manufactured by a method according to the invention have a greater tensile strength than optical fibres manufactured by prior-art methods.

The invention also relates to apparatus suitable for performing a method according to the invention, which apparatus comprises a holder for an optical fibre preform, a furnace, a coating device, a drying device, a drawing device and a winding device, the furnace comprising a graphite resistance-element bounding a central heating chamber, the furnace having an inlet bore containing sealing means, an exit bore, and a supply duct for the supply of a gas is characterized in that the furnace is provided with a tubular condenser which is arranged in the exit bore, the centre lines of the condenser and of the heating chamber coincide, one end of the condenser is located inside the heating chamber and the other end is disposed outside the furnace. The tubular condenser has a hot end and a relatively cool end, there being a substantial temperature drop along the length of the condenser. Owing to the comparatively great length of the condenser, the optical fibre drawn from the optical fibre preform is surrounded and protected by the condenser over practically the entire cooling path, which condenser contains a gas stream which envelops the optical fibre being drawn.

One embodiment of an apparatus suitable for

the circle inscribed in that portion of the polygon of constant cross-section, is approximately 10% greater than the outer diameter of the optical fibre F to be coated. This prevents the fibre F from coming into contact with the segments. The operation and the effect of the polygonal nozzle opening in accordance with the invention has already been described above.

Claims

1. A method of manufacturing an optical fibre, comprising the steps of heating an optical fibre preform in a furnace so as to melt one end of the preform, drawing an optical fibre from the molten end of the platform, withdrawing the optical fibre from the furnace, enveloping the portions of the preform and of the optical fibre which are within the furnace in an inert gas stream, cooling the optical fibre, coating the optical fibre with a layer of a synthetic resin and winding the coated optical fibre onto a reel, wherein the gas stream enveloping the optical fibre passes from the inside of the furnace to the outside of the furnace through a condenser element which surrounds the optical fibre, and wherein an overpressure of the inert gas is maintained inside the furnace with respect to the pressure outside the furnace.

2. A method of manufacturing an optical fibre, comprising the steps of heating an optical fibre preform in a furnace so as to melt one end of the preform, drawing an optical fibre from the molten end of the preform, withdrawing the optical fibre from the furnace, enveloping the portions of the preform and of the optical fibre which are within the furnace in an inert gas stream, cooling the optical fibre, coating the optical fibre with a lacquer, drying the coated optical fibre, and winding the dried coated optical fibre onto a reel, wherein the as stream enveloping the optical fibre passes from the inside of the furnace to the outside of the furnace through a condenser element which surrounds the optical fibre, and wherein an overpressure of the inert gas is maintained inside the furnace with respect to the pressure outside the furnace.

3. A method of manufacturing an optical fibre, substantially as herein described with reference to Figures 1 to 3 together with Figures 4*a* and 4*b* or Figures 5*a* and 5*b* or Figures 6*a* and 6*b*.

4. An optical fibre manufactured by a method as claimed in any of Claims 1 to 3.

5. An apparatus suitable for performing a method as claimed in Claim 2, comprising a holder for an optical fibre preform, a furnace, a coating device, a drying device, a drawing device and winding device, the furnace comprising a graphite resistance-element bounding a central heating chamber, the furnace having an inlet bore containing sealing means, an exit bore, and a supply duct for the supply of a gas, characterized in that the furnace is provided with a tubular condenser which is arranged in the exit bore, the centre lines of the condenser and of the heating chamber coincide, one end of the condenser is located inside the heating chamber and the other end is disposed outside the furnace.

6. An apparatus as claimed in Claim 5, characterized in that the condenser is secured in a central bore of a substantially cylindrical support, which support fits into the exit tube of the furnace and is provided with a plurality of outlet ducts, through which ducts gas can pass from inside the furnace to outside the furnace.

7. An apparatus as claimed in Claim 5 or Claim 6, characterized in that the condenser is made of quartz glass.

8. An apparatus as claimed in Claim 5 or Claim 6, characterized in that the condenser is made of platinum.

9. An apparatus as claimed in any of Claims 5 to 8, the coating device comprising a coating reservoir which is provided with a polygonal nozzle opening.

10. An apparatus as claimed in Claim 9, characterized in that the nozzle opening is bounded by a plurality of adjustable segments.

Printed for Her Majesty's Stationery Office by the Courier Press, Leamington Spa, 1980. Published by the Patent Office, 25 Southampton Buildings, London, WC2A 1AY, from which copies may be obtained.